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ABSTRACT

In this study, the attitudes of Israeli children aged 6 to 15 years were surveyed regarding their conceptions of plants as living things. It was desired to find out whether children consider plants to be alive, the knowledge differences between the different age groups in the study, how children classify plants according to biological criteria and correlations between the classification according to the concept of living/non-living and the classification according to biological criteria. Both individual interviews and paper-and-pencil questionnaires were used in which children were asked to classify animals, plants and inanimate objects. It was found that: (1) there was a high percentage of incorrect classifications of plants at all ages; and (2) there were no consistent connections between the classification of plants into living/non-living and according to biological criteria. The study proposes that part of the deviance of Israeli children from others in other research studies could be explained by characteristics of the Hebrew language. (CW)

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CHILDREN'S CONCEPTIONS OF PLANTS AS LIVING THINGS

Naomi Wax and Ruth Stavy

The problem which is the subject-matter of this paper arose in the process of our work in science curriculum development for elementary school children in Iarael. As we were dealing with the life-cycle of plants, it became clear to us that many of the 10 - 12 year olds do not perceive plants as living things in the full sense of the term. Quite a few children who belonged to this group, whether from an urban or rural background, thought that seeds originate in shops or factories and that flowers, even wild ones, grow in the fields only because man planted them there or because they are the direct product of the earth. The same group of children, and even those younger, had an entirely different attitude to animals, such as worms, to be found in fruit or in rotten meat: they knew that they originated from animals (flies, worms) that had been there before.

Pupils in junior high schools (13 - 15 years old) even pointed out that they would not call plants living things. As one of them put it: "Plants are somthing half-way between the living and the inanimate." [The same confusion is to be found among adults. Take the case of the person who declares, while eating lettuce, that she would never eat a living thing. (Crick, 1966, p.3)].

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Following upon these impressions, we resolved to investigate in detail whether, and in what way, children conceptualize the status of animals and of plants as living things. It seemed to us supremely important to find out whether indeed children perceive plants, along with animals, as living things; for this is a self-understood assumption at the basis of the teaching of the life sciences.

In the literature dealing with the development of the concept of life, there is only scant attention paid to the way children perceive plants as living things as contrasted with the manner in which they form the notion of living things by relating to animals.

According to Piaget (1973) and his followers, children who classified animals or animals and plants as living things achieved the fourth and last stage of the development of the concept of life. (Without distinguishing between children who attribute life to animals alone from those who attribute life to animals and plants)

Some other investigators such as Richards and Siegler (1984), as well as Carey (1985), make a distingtion between the stage in which children do not yet perceive plants as living things and the stage when they judge correctly that they are living, Richards and Siegler found that 98% among the 8 and 9 year olds judged plants to be alive, while Carey found that by the age of

10 all children whom she investigated, attribute life to plants and animals and thus form the correct biological concept of a living thing (similar results were obtained by King (1961) and Stephan (1985), who found that by the age of 11 more than 90% of children consider trees, flowers and plants in general to be alive.)

Our own observations, however, as already stated above, were some-what different. Therefore we undertook to survey the attitudes of children in the 6-15 years old age group, with the intention of fixing, as precisely as we could, the stage they have reached in the process of their concept-formation. More specifically, we wanted to gain clarity on the following questions:

(1) Whether children consider plants to be living things.

(2) What, if any, is the difference between the different age groups within our target population.

(3) How do children classify plants according to biological criteria (e.g. respiration, reproduction, feeding, growth).

(4) What, if any, is the correlation between the classification according to the joint concepts living/non-living and the classification according to the biological criteria (growth, respiration etc.). In addition we sought to make sense of the explanations that children themselves gave to their

classifications; and to relate this understanding, in order to improve the methods of teaching biology in schools.

We shall now report briefly on the work we have done and the results we obtained. In the first stage of our research we conducted individual interviews. Children at the age of 8-12 were asked in the Piagetian procedure standardized by Laurendeau and Pinard (196 2). The results, which are similar to what was found in the second stage of the research, are presented in Table 1.

Insert Table 1 about here

In the second stage, paper and pencil questionnaires were administered to all age groups between 6 and 15, altogether 300 children. 4 sets of questions were posed. The first set was comprised of questions relating to the living/non living classification

The question posed in the first questionnare were:

Is X a living thing?

What makes you think so?

For the variable "X" above, the following particulars have been substitutied: six animals: man, cat, bird, fish, fly and worm, Four palnts: flower, tree, bush and grass. Six inanimate objects: fire, cloud, motorcar, hammer, table and stone. The above objects were presented in a random manner.

When presenting the items listed above subjects were asked to mark the items with plus or minus signs for living or non-living, with the option to indicate that in the view of the subject the X under examination is neither living nor not-living.

In addition we asked four other sets of questions. All questions belonging to these four sets were related to the bilogical criteria: respiration, reproduction, feeding and growth.

The main results of this second stage of inquiry are presented in Fig.1.

Insert Fig. 1 about here

Fig. 1 shows the correct answers given to the living/non-living questions. It shows the answers given to three kinds of objects: animals, inanimate objects and plants. It is clear that from the age of 6 all answers regarding animals are correct: all children know that these are very much alive. As for the inanimate objects, only 80% of the 6-10 years old age-group give the right answer, the error is chiefly accounted for by the mistaken attribution of life to things like fire and cloud. Regarding the same question the older group, 10-15, has a result which is 90% correct.

Coming now to plants, the focus of our interest, only 30 to 60 percent, in the age group of 6-11, classify plants correctly as living things. In the age group 12-15 there are less mistakes made but even here the success of classifying plants as living things does not rise above 80%. Some of the children who misclassified plants, even create a separate category for plants, as neither fully living nor inanimate.

The following Figures (2-4) summarize the answers given to questions relating to animals, inanimate objects and plants as related to biological criteria.

Insert Fig. 2 about here

It is readily seen that in the case of animals (Fig. 2) there is an exteremely close correlatin between the atrribution of biological characteristics with the classification in terms of living/non-living.

Insert Fig. 3 about here

In the case of inanimate objects, Fig.3 children do better as they get older, while the high proportion of mistaken answers in the lower age groups is to be explained, as stated above, by the inclination of this age-group to wrongly classify fire, cloud etc.

Insert Fig. 4 about here

It is different when we come to plants(Fig. 4). Here there is almost a total absence of correleation between the attribution of biological characteristics and the living/non-living sorting. This lack of correlation is manifest in all age-groups.

For example, one child who asserted that a flower was not a living thing, yet answered affirmatively when asked whether flowers grow. This result can be made more visible by considering individual classes separetely (Fig.5) .

Insert Fig. 5 about here

In our view, the most significant aspects of these results are:

(1) There is a rather high percentage of wrong classification of plants according to the lines of living/non-living, even in the higher age groups of the target population, e.g. in the age group of 11-12 only 55% of the children answered correctly.

(11) There does not seem to be a consistent connection between classification of plants into living/non living, and classification according to biological critertia. In addition, there is only a very lose connection between the classifications

and the reasons which are given to explain them. For example, a subject may reply that X is alive because it breathes, yet when asked seperately whether X is breathing he replied in the negative . The high percentage of wrong classifications of plants, is contrary to what we should have expected on the basis of existing literature on the subject. Thus, there is, if our methods have been correct, something in need of explanation about Israeli children.

It seems to us that at least part of the explanation of the "deviance" of Israeli children from what is to be "expected" of them on the basis of research done elsewhere, is to be sought in the characteristics of the Hebrew language. (See Table 2)

Insert Table 2 about here

As is readily seen the word for plants in Hebrew, not like the word for animal, does not include the word for life or any of its cognates. In addition the verbs describing plant's growth and death are different than those for animals. Thus it is easily understandable that the first, untutored classifications children make of the things to be found around them, are influenced by the logic implicit in their native tongue. Seen from this point of view, our research is a support for the view, that language is more than a mere tool for expressing, culture-independent or "natural," thoughts, but that it is

rather a whole Philosophy of life in itself. The same linguistic differentiation can be found also in the bible (genesis, 1;30).

"And to every beast of the earth, and to every bird of the heavens, and to everthing that creepeth upon the earth, wherein there is life, I have given every green herb for food, and it was so".

Clearly, the "non-living" green herb is just food for everything in which "there is life". Once is a case where the scientific concepts are clearly at variance with the instuitions supported by language. It is worth our attention to observe the process, as children get older, by which these "native" intuitions give way to scientific concepts.

As for the secound result: We have seen that there is a poor correlation between the attribution of life and the ascription of biological characteristics to plants. This circumstance raises some doubts about the level of true understanding that these children have about the phenomenon of life as such.

It seems that even children who correctly classify objects according to the living/non-living criterion, use the terms living thing, life, alive etc, without understanding its biological meaning.

Our future research will focus on further investigation of this issue.

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Table 1: Percentages of children who correctly related to plants as living things (Stage 1).

Questions	age group		
	8-9 (N=8)	10-11 (N=8)	11-12 (N=8)
Are plants living things?	69%	69%	57%
Do plants breath?	13%	69%	75%
Do plants eat?	70%	75%	88%
Do plants grow?	100%	100%	100%
Do plants reproduce?	44%	90%	66%

Table 2: Hebrew words for different English words related to plants as living things

English	Hebrew
life	CHAIm
alive	CHAi , CHAIa
living thing	davar CHAi
animal	baal CHAIm, CHAi
plant	ZeMaCH
plants, Vegetation	ZoMeaCH
grow (for animals)	gadel
grow (for plants)	ZoMeaCH
die (for animals)	meth
die (for plants)	novel
breath	NoSHeM
	NeSHaMa = (Soul)

Fig 1: Percentage of children who correctly classified animals, plants and inanimate objects according to living / non living criterion in the different grades.

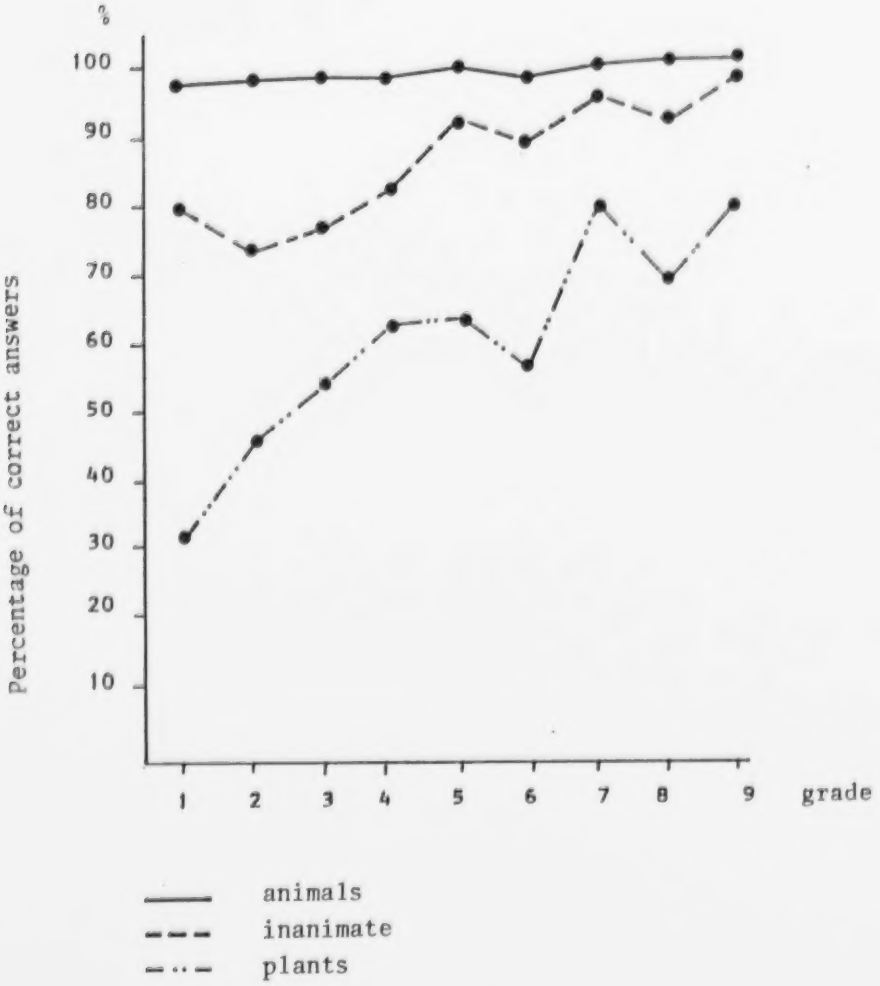

Fig 2: Percentage of children who correctly classified animals according to biological criterie in the different grades.

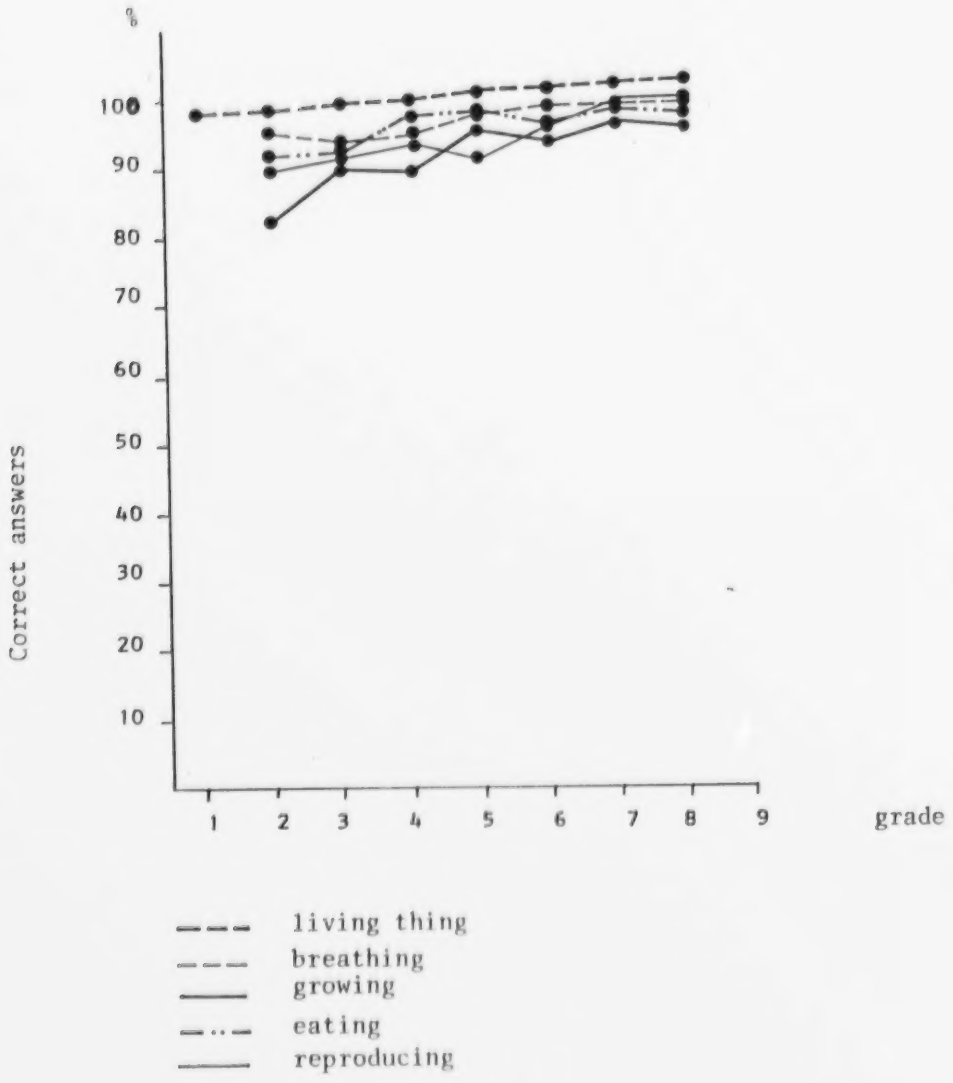

Fig 3: Percentage of children who correctly classified inanimate objects according to biological criteria in the different grades.

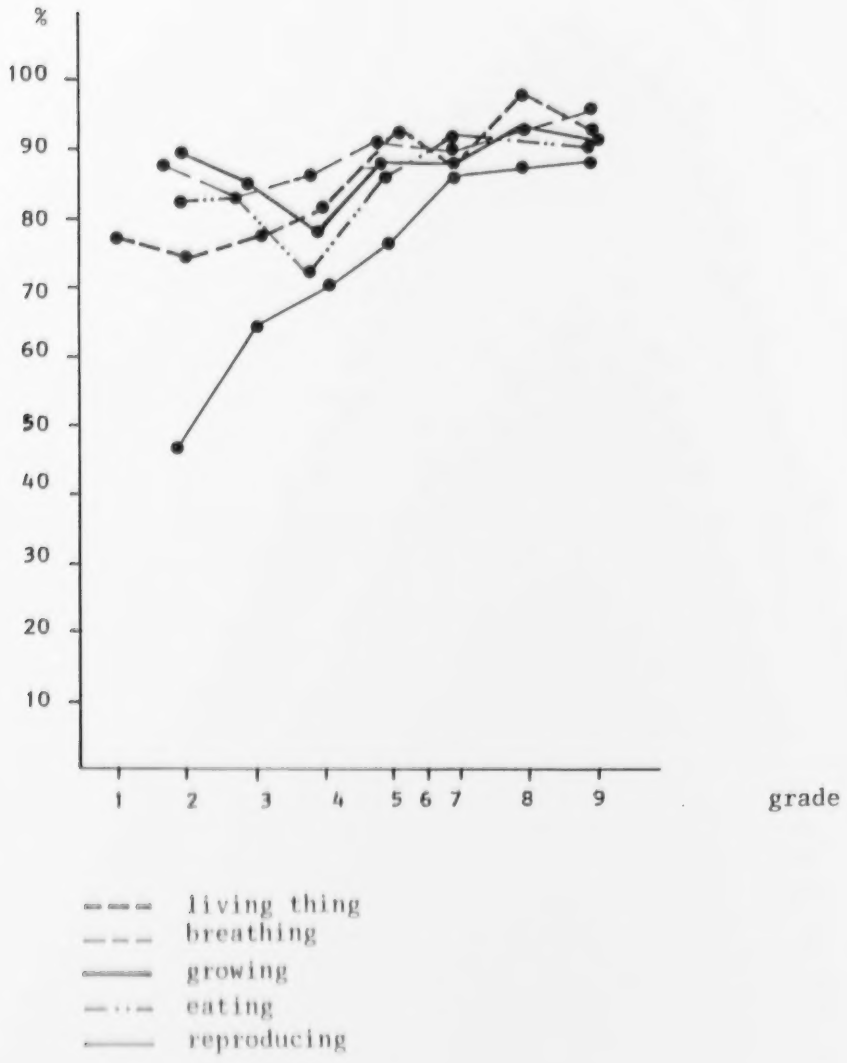

Fig 4: Percentage of children who correctly classified plants according to biological criteria in the different grades.

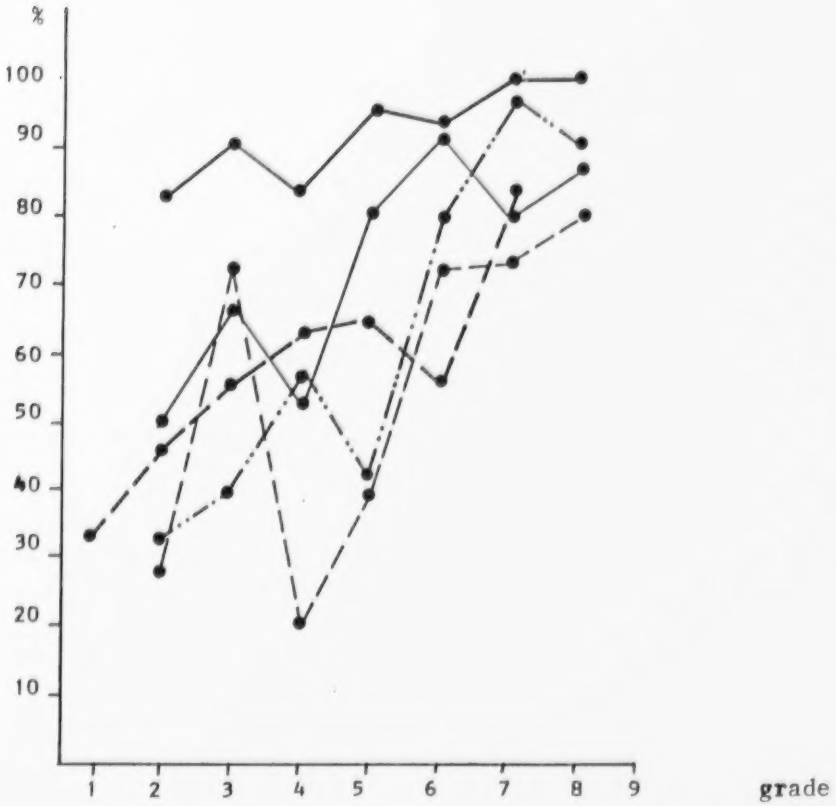

Fig 5: Percentage of sixth children who correctly classified the different objects according to biological criterie